

A TAXONOMIC REVIEW OF THE SUBGENUS *PHYTOHELEA* OF  
*FORCIPOMYIA* (DIPTERA: CERATOPOGONIDAE)

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*Abstract.*—The subgenus *Phytohelea* Remm of the genus *Forcipomyia* Meigen is reviewed, with a diagnosis and a key to species. On the basis of female characters 18 of the 22 known species are divided into three taxonomic groups; good specific differences are found in the males and immature stages. The larvae live in water found in the leaf axils of a wide variety of plants in the tropics and subtropics and feed on detritus. Apparently they are readily transported in such plants by commerce, especially in pineapples and other bromeliads. Three new species are described: *belkini* from New Zealand, *dominicana* from Dominica, W.I., and *tzaneenensis* from South Africa and Ghana. *Lasiohelea natalia* de Meillon from Natal is synonymized with *F. bacoti* (Ingram and Macfie) (NEW SYNONYMY). A lectotype is designated for *F. bacoti*.

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There has been no previous attempt to review the subgenus *Phytohelea* Remm largely because of a paucity of material, especially of the immature stages. The adults are drab little creatures, and all look more or less alike. The male genitalia, which show such striking specific differences in other subgenera of the genus *Forcipomyia* Meigen, are of limited value and often have to be dissected and stained for their structure to be revealed. Many specimens from museums are on slides, some many years old, and to dissolve them off, reprepare, dissect, and stain if necessary, is laborious and risky because the small structures are easily lost.

For many years it has been known that the immature stages of *Forcipomyia* often provide striking specific differences when adults do not (Saunders, 1925; Mayer, 1933), and the latter author attempted to construct a key to the then known immature stages of six species of *Phytohelea*. The correct

association of immatures with the adult has been a constant problem. The pupa can, in the most cases, be accurately assigned because the tough pupal exuviae may be readily recovered along with the associated reared adult. The larva, on the other hand, sheds a diaphanous, fragile, colorless skin that is difficult to handle and indeed even difficult to find. It is well known that more than one species may frequent the same habitat so great care has to be taken in assigning any particular larva unless a direct association has been made by rearing the adult.

The subgenus *Phytohelea* is now known from the tropics and subtropics of the Americas, Africa, Southeast Asia, and the Pacific. There is little doubt that it will be found to be widespread and the species fairly common in these regions. Apparently the immature stages are readily transported in leaf axils of plants over long distances, and some species may have extended their distribution thusly through commerce (Tokunaga, 1961).

The subgenus is of no medical or veterinary importance since adult females do not take blood meals. In agriculture the larva of *F. brevis* (Johannsen) was reported by Johannsen (1927) as damaging the tender leaves of pineapple, thus allowing onset of bacterial rot, which may kill the plant. Later, however, Illingworth (1934) stated that there was no conclusive evidence that the larvae induced the infections.

Taxonomic material has been made available by the National Museum of Natural History (abbreviated USNM), the British Museum (Nat. Hist.) (BMNH), the South African Institute of Medical Research (SAIMR), and Cornell University (CU). A species described below as new was collected by the senior author at Tzaneen, South Africa, in 1976.

Though the material available has allowed no more than a preliminary review, it has been found possible to divide 18 of the 22 known species into three species groups, thus bringing some order into the taxonomy of the subgenus. Unfortunately the main features that allow this division are peculiar to females; no male or immature characters have so far been found in support. For this reason the following species, known only in the male sex, *fijiensis* Macfie, *hamaticauda* Tokunaga, *keilini* Saunders, and *sabroskyi* Tokunaga, are not included in the keys but they are compared with the males of other species where relevant.

An explanation of the terminology used in this paper can be found in the excellent basic papers by Saunders (1924, 1925, 1956) and Tokunaga and Murachi (1959).

*Forcipomyia* subgenus *Phytohelea* Remm

*Forcipomyia*, subgenus *Phytohelea* Remm, 1971:189. Type-species, *Ceratopogon bromelicola* Lutz (original designation).

*Apelma* Kieffer of Saunders, 1925:252.

*Trichohelea* Goetghebuer of Saunders, 1956:695.

REFERENCES: Saunders, 1925:252 (all stages; habits; revision; as *Apelma*); Saunders, 1956:695 (revision, all stages; as *Trichohelea*); Chan and LeRoux, 1971:754 (figures; all stages; as *Trichohelea*).

Diagnosis.—Tarsal Ratio 2.0–3.2. Basal flagellar segments of female antenna compressed, some may be missing in some species. Palpus 5-segmented; 4th and 5th segments fused or not; 3rd segment with definite sensory pit. Empodium present in female; present, absent, or vestigial in male. Wing with sparse macrotrichia, iridescent, unmarked; costa ending at or near middle of wing; 2nd radial cell open in female, longer than in subgenus *Forcipomyia*. Spermathecae 1 or 2. Male genitalia with 9th sternum broad and short; aedeagus variably shield shaped; parameres spatulate, joined by stout crossbar, with a pair of stout anterior processes extending back from basistylar apodemes, the complex appearing as an H-shaped structure in ventral view.

Immature stages.—Larva with head flattened, prognathous, roughly rectangular in dorsoventral view; antenna reduced to circular windows on front corners of head, containing minute sensoria; body elongate, vermiform, dorsoventrally flattened, with many fine lateral chaetae often “finned,” few dorsal; characteristic dorsal pair of chaetae arising from sclerotized crossbar (dorsal plate) on posterior margin of penultimate segment; prothoracic pseudopod conical, bearing many curved hairlike and broader hooklets beyond a row of short, stout hooks; anal pseudopod provided with thornlike hooks and slender, hyaline hooklets, the outermost usually stouter and serrate on inner surface; body ending in a dorsal, median, bluntly conical point regarded as a cauda; 2 pairs of anal blood gills often bifurcate, fine pointed; cuticle devoid of armature.

Pupa elongate, agile, never retaining larval exuviae; chaetae few to none on thorax, tubercles mostly armed with spines and short setae on abdomen; prothoracic respiratory horn small with narrow base, a U-shaped row of spiracular openings at tip; terminal rami widely spaced, short or long and attenuated, with a small or large seta on outer surface; genital processes of male ventral.

Habits.—Larvae are found living submerged in water-filled leaf axils of water-holding plants such as bromeliads, *Dracaena*, *Pandanus*, *Colocasia*, *Alocasia*, *Cordyline*, and *Musa*. The pupa leads an active submerged life. When the imago is ready to emerge, vigorous writhing motions bring the pupa up out of the water.

Illingworth (1934) reported on the biology of *F. brevis* in Hawaii as follows: “Investigating pests of pineapples, I discovered the larvae of these tiny midges usually present in water which collects in the axils of the central leaves. Apparently these larvae feed upon wind-borne, decomposing organic matter that naturally washes down into their retreat. I should note, however,

that the mouth of the larva is provided with a pair of needle-like hooks, which it uses in pulling itself forward. These hooks are capable of puncturing the tender white tissue at the bases of the leaves, and possibly they do this in the ordinary movements of the maggot. But there are no visible abrasions of the epidermis and we have no conclusive evidence that they cause infections."

Illingworth further noted the oviposition habits and life-history of this species: "Tracing the life history I found difficulty, at first, in locating the eggs of the fly. Later, however, I discovered that they are not placed down in the water pockets, as one might expect, but higher up on the leaf blade—at about the lower edge of the green area where it joins the white. The eggs are cigar shape and quite dark in color, about one-half millimeter in length. The incubation period lasts four days, when the larva splits the shell down over half its length, and crawls out. After feeding for twenty-eight to forty-five days the larvae pupate in the water pockets, and emerge as flies four days later. Thus the whole life cycle requires a period of only thirty-six to fifty-three days—and there is a continual series of development throughout the year."

Distribution.—Pantropical.

Included species (with stages known: male (m), female (f), larva (l), pupa (p), all stages (all)):

*alocasiae* Tokunaga, 1961:120. New Britain (all).

*antiguensis* Saunders, 1956:700. Antigua, W.I. (all).

*bacoti* (Ingram and Macfie), 1923:55 (*Apelma*). Sierra Leone (m, f, p).

*belkini*, NEW SPECIES. New Zealand (all).

*brevis* (Johannsen), 1927:205 (*Apelma*). Hawaii (all).

*bromelicola* (Lutz), 1914:84 (*Ceratopogon*). Brazil (all).

*caribbeana* Saunders, 1956:696. Trinidad (all).

*comis* Johannsen, 1931:409. Sumatra, Java, Bali (all).

*crinume* (Tokunaga), 1932:1 (*Dasyhelea*). Japan (all).

*dominicana*, NEW SPECIES. Dominica (all).

*edwardsi* (Saunders), 1925:260 (*Apelma*). Brazil (all).

*fijiensis* (Macfie), 1945:1 (*Apelma*). Fiji (m).

*grandis* Chan and LeRoux, 1971:758. Singapore (all).

*hamaticauda* Tokunaga, 1959:212. Caroline Islands (m).

*jocosa* Saunders, 1956:701. Trinidad (all).

*keilini* (Saunders), 1925:266 (*Apelma*). Brazil (m, l, p).

*magna* (Saunders), 1925:266 (*Apelma*). Brazil (all).

*marksae* Tokunaga, 1961:117. New Guinea (all).

*natalia* (de Meillon), 1936:158 (*Lasiohelea*). Zululand. Synonym of *bacoti*

(Ingram and Macfie). NEW SYNONYMY.

*nicopina* Chan and LeRoux, 1971:754. Singapore (all).



- oligarthra* Saunders, 1956:698. Puerto Rico (all).  
*sabroskyi* Tokunaga, 1959:211. Caroline Islands (m).  
*tzaneenensis*, NEW SPECIES. South Africa, Ghana (all).

#### KEY TO THE SPECIES GROUPS IN *PHYTOHELEA*

1. Female with 1 spermatheca; pupa with caudal rami about as long, or longer, than abdominal segment IX ..... *comis* Group
- Female with 2 spermathecae; pupa with caudal rami usually shorter than segment IX ..... 2
2. Female antenna with 11 segments ..... *oligarthra* Group
- Female antenna with 15 segments ..... *bromelicola* Group

#### THE *COMIS* GROUP

The species of this group are *alocasiae*, *comis*, *grandis*, and *tzaneenensis*. Females of the *comis* Group are characterized by having a single spermatheca. All pupae of this group have the caudal rami very long and finely attenuated and the caudal seta minute or even absent. This is not a unique characteristic of this group as it is shared by pupae of *marksae* and *dominicana* of the *bromelicola* Group.

With the exception of some small differences in the male genitalia it has not been found possible to separate the adults of the species in this group. The following examples will serve to illustrate the similarity of different species. Tarsal ratio of the hind leg (numbers of specimens examined in parentheses): *comis* 2.9 (2); *tzaneenensis* from Ghana 2.4–3.0 (7), from Tzaneen 2.0–2.5 (5); *grandis* 2.3–3.2 (4); *alocasiae* 2.8–3.0 (number examined not stated). Antennal ratios (male iii–xi/xii–xv, female iii–x/xi–xv) remarkably constant; in male 1.0–1.2 and in female 0.6–0.7. The wing length in millimeters varies as follows: *tzaneenensis* 0.8–1.0; *comis* 1.0–1.1; *grandis* 0.7–0.8; *alocasiae* 1.0. In all specimens the costa reaches to about the middle of the wing. No palpal differences of any moment could be detected but in *tzaneenensis* the sensory pit was a little deeper than in the other species.

Until such time as adults are reared and larval and pupal skins preserved the state of knowledge of this group will remain uncertain. With the material and descriptions of authors at hand the following tentative key is presented:

#### KEY TO SPECIES OF THE *COMIS* GROUP

1. Pupal respiratory horn with more than 20 apical spiracular openings ..... *comis* Johannsen
- Pupal respiratory horn with less than 20 spiracular openings ..... 2
2. Larva with lateral seta of anal segment modified; male paramere pointed and sclerotized apically ..... 3

- Larva with lateral seta of anal segment not modified; male paramere smoothly rounded apically (Fig. 1) . . . . . *tzaneenensis*, new species
- 3. Larva with lateral seta of anal segment leaflike, serrated . . . . .  
 . . . . . *grandis* Chan and LeRoux
- Larva with lateral seta of anal segment flattened but not serrated . .  
 . . . . . *alocasiae* Tokunaga

The paucity of material plus the inadequacy of some illustrations in the literature have prompted us to provide figures to aid in future studies. Figures 4 and 8 illustrate the genitalia of a *comis* male identified by Johannsen. The difference in the shape of the parameres of *tzaneenensis* is obvious though the aedeagi are very similar in the two species.

*Forcipomyia (Phytohelea) alocasiae* Tokunaga

*Forcipomyia (Trichohelea) alocasiae* Tokunaga, 1961:120 (all stages; New Britain; figs.).

Types.—Holotype ♀, allotype ♂, paratype ♂♂, larvae, and pupae, Vudal, SW of Keravat, New Britain, 21.iv.1958 (Marks), in axils of *Alocasia* at edge of primary rainforest (types in Bishop Museum, Honolulu; University of Queensland, Brisbane; and Entomology Laboratory, Kyoto Prefectural University, Kyoto, Japan).

Specimens examined.—None available.

*Forcipomyia (Phytohelea) comis* Johannsen

Figs. 4, 8

*Forcipomyia (Apelma) comis* Johannsen, 1931:409 (male, female; S. Sumatra, Middle and East Java, Bali; fig. male genitalia).

*Apelma comis* (Johannsen); Mayer, 1933:225 (larva, pupa; figs.; distribution; larval habitats and biology).

Types.—Syntypes (in BMNH) from Bali (east of Baturiti, 790 m), Java (Lake Bedali in East Java; Lake Ngebel and Nglekok in Middle Java, and Buitenzorg Botanical Garden in West Java); South Sumatra (Kapala Tjurup), all taken in leaf axils of *Colocasia* by A. Thienemann).

Specimens examined.—INDONESIA: Sumatra, 1928–9, A. Thienemann, in *Colocasia*, 2 ♂, 1 ♀ (det. O. A. Johannsen) (BMNH, syntypes). NEW HEBRIDES: Port Patrick, 1.iii.1953, M. Laird, in leaf axils of taro, 1 larva (USNM). SW Espirito Santo, Namatasopa, 2500 ft., M. Laird, in leaf axils of taro, 2 larvae (USNM). SOLOMON ISLANDS: Guadalcanal, Talamu, 8.vii.1953, 3030 ft., M. Laird, in leaf axils of *Colocasia*, 1 larva, 2 pupae (USNM). Guadalcanal, Tuturahitoko, 1900 ft., 6.viii.1953, M. Laird, in leaf axil of *Alocasia*, 1 larva (USNM).

In the Laird collections the pupae were not mature so together with the

larvae their identification remains uncertain. Mayer (1933) described the larva and pupa of *F. comis* from material from Indonesia provided by Thiemann. The larvae and pupae in the Laird collections differ significantly from Mayer's descriptions, and it is unlikely that they are *comis* (Laird, 1956).

*Forcipomyia (Phytohelea) grandis* Chan and LeRoux

*Forcipomyia (Trichohelea) grandis* Chan and LeRoux, 1971:758 (all stages; Singapore; figs.).

Types.—Holotype, pupa, Wallace Way, Singapore, v.1962, K. L. Chan, collected in watery detritus in leaf axils of *Colocasia* sp. (deposited in Lyman Entomology Museum, McDonald College, Quebec). Paratypes, 9 larvae, 2 pupae, 1 ♂, 1 ♀ (Chan collection).

Specimens examined.—Wallace Way, Singapore, x.1961, leaf axils of *Colocasia*, K. L. Chan, 4 ♂, 2 ♀ (topotypes, USNM).

*Forcipomyia (Phytohelea) tzaneensis* de Meillon and Wirth,  
NEW SPECIES

Figs. 1-3, 5-7, 9-13, 27

The following description is from the male holotype; the figures in parentheses are the ranges in 5 paratypes. A small dark species with legs paler as commonly seen in the genus.

Male.—Wing length, measured from the arculus 0.95 (0.90-1.00) mm.

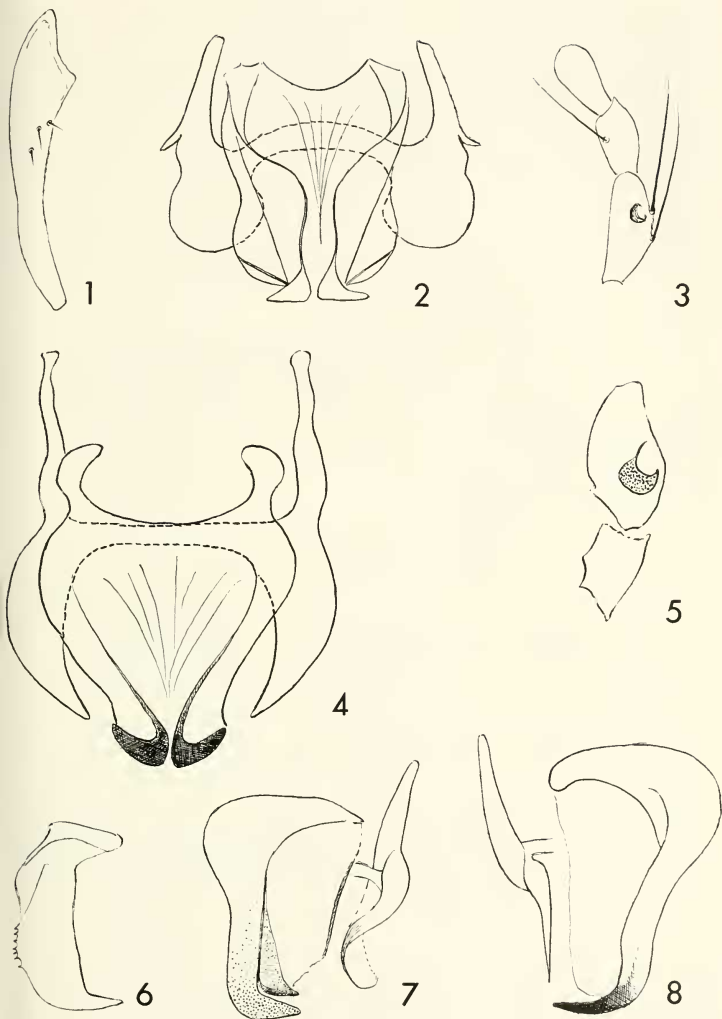
*Head*: Dark brown, eyes narrowly separated, bare. Palpus (Fig. 3) with lengths of segments II-V in proportion of 30-45-30-28 (25-30, 40-50, 25-30, 25-30); 3rd segment slightly swollen with a moderately deep sensory pit. Antenna with segments IV-XI wider than long, gradually narrowing to XI which is about as long as wide; XII-XV with lengths in proportion of 53 (50-60), 70 (60-80), 60 (55-60), 80 (65-80) (including the apical papilla); antennal ratio (III-XI/XII-XV) 0.9 (0.8-1.0).

*Thorax*: Scutum, scutellum, postnotum and pleuron except for membranous parts, dark brown. Wing with ratio of costa to wing length 0.45 (0.44-0.46); 1st radial cell a mere slit seen in stained specimens, 2nd radial cell open, well developed as usual in the subgenus. Legs pale brown, without any darker margins; tarsal ratios of front, middle, and hind legs respectively:

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Figs. 1-3. *Forcipomyia tzaneensis*. 1, Dististyle of holotype, ventral view. 2, Aedeagus and parameres of holotype, ventral view. 3, Segments III-V of male palpus. Fig. 4. *F. comis*, aedeagus and parameres of a male identified by Johannsen, ventral view. Figs. 5-7. *F. tzaneensis*. 5, Segments II-III of female palpus. 6, Side view of aedeagus showing small teeth on ventral side. 7, Aedeagus and parameres of holotype, side view. Fig. 8. *F. comis*, aedeagus and parameres of a male identified by Johannsen, side view.



2.3 (2.0–2.3), 2.3 (2.0–2.5), 2.3 (2.0–2.5); empodium absent; claws only slightly curved.

*Abdomen:* Dark brown dorsally, venter a shade paler. Genitalia (Fig. 1) with basistyle parallel sided,  $3\times$  as long as wide; dististyle in ventral view gradually tapering to a rounded point but more pointed when viewed from another angle; aedeagus (Fig. 2) shield shaped, with a pair of dorsally directed sclerotized hooks apically, this and the sclerotized dorsal portion of the shield best seen in side view (Fig. 7); parameres (Figs. 2, 7) fused as usual, each apical process rather membranous, short and well rounded, the precise shape difficult to see unless dissected free of the 9th segment. In some Ghana specimens the aedeagus showed a few minute dorsal teeth along the ventral side (Fig. 6); such specimens could not be separated from the others by any other features.

Female.—Wing length measured from the arculus 0.80–0.85 mm.

*Head:* Eyes narrowly separated, bare. Palpus (Fig. 5) with lengths of segments II–V in proportion of 25-40(45)-30-25; 3rd segment swollen with a deep sensory pit (some variation in this character is apparent in Ghana specimens). Antenna (Fig. 27) with lengths of segments XI–XV in proportion of 35-40-40-40-65; IV–X transverse, about  $2\times$  as wide as long; antennal ratio (III–X/XI–XV) 0.5–0.6.

*Thorax:* As in male. Wing with ratio of costa to wing length 0.4–0.5; radial cells as in male. Legs with tarsal ratios of front, middle, and hind legs, respectively: 2.3–2.5, 2.3, 2.6; empodium developed; claws moderately curved.

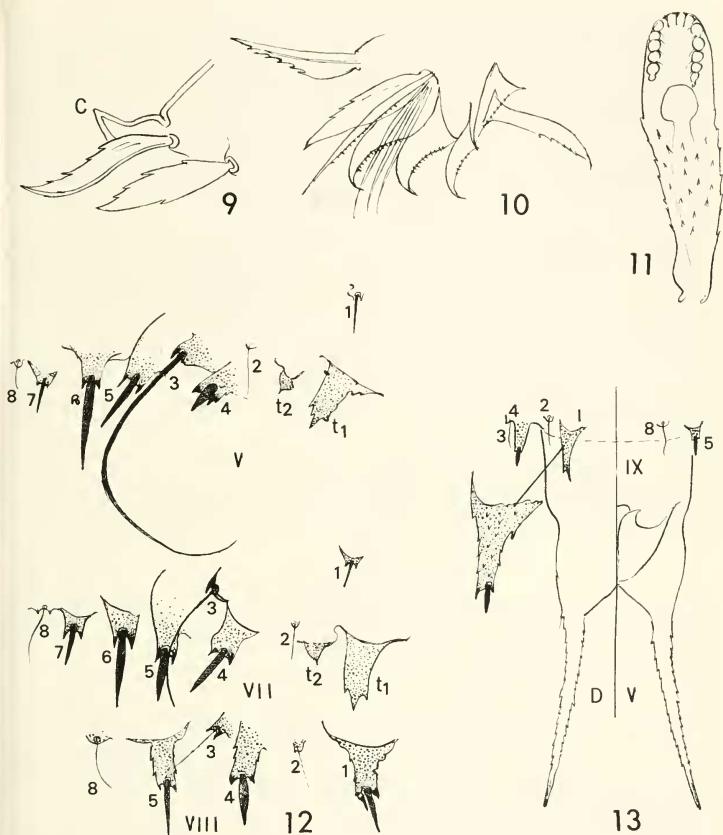
*Abdomen:* Spermatheca single, pear shaped; sclerotized, and including the neck measuring 0.062 by 0.039 mm.

Pupa (Figs. 11–13).—Described from the pupal exuviae of the holotype.

*Cephalothorax:* Very faintly pigmented, some shagreen dorsally where there are 4 small raised tubercles; operculum with 3 larger tubercles. Respiratory horn more or less straight sided, measuring 0.20 mm long by 0.04 mm at its widest (Fig. 1); spiculate with 16–17 apical spiracular openings. Abdomen<sup>1</sup> nearly colorless; the noteworthy features are: (1) setae 3 and 4 of segment V on separate tubercles; (2) tubercles 1 and 2 well developed; (3) caudal rami longer than segment IX, caudal seta minute or apparently absent (Fig. 13). There is some variation in the size of tubercles *t*<sub>1</sub> and *t*<sub>2</sub>, but on the whole as figured (Fig. 12).

Larva.—According to Saunders (1925) the larva of *Forcipomyia* has 3 thoracic and 8 abdominal segments, segment VIII being divided into 2 portions, the terminal portion of which bears the posterior pseudopod. We refer to the penultimate portion as the VIIIth segment, and the terminal as the

<sup>1</sup> Here as elsewhere we use the notation of de Meillon (1936) for the setae with addition of "t" for tubercles without spines or hairs.



Figs. 9–13. *Forcipomyia tzaneensis*. 9, Larva, portion of anal segment showing upright cauda and two leaflike serrated setae of one side (c, cauda). 10, Larva, tail end showing some of the modified setae on one side. 11, Pupal respiratory horn. 12, Pupa, tubercles and setae of abdominal segments V, VII, and VIII (for legend, see text). 13, Pupa, abdominal segments VIII and IX, dorsal left, ventral right.

anal segment to facilitate the descriptions. The descriptions and the figures are from several Tzaneen specimens including exuviae of reared adults. Whole larvae are poorly preserved and mounted so little use is made of them.

Head light brown, slightly longer than broad, setae all small, delicate, and



simple. Prothoracic pseudopod apparently of the usual type though not well displayed in any of the specimens. Abdominal setae all small, short and delicate; the 2 setae on the dorsal plate of segment VIII shorter than anal segment; dorsal apex of anal segment without the pair of short, stout setae seen in larvae of many species; cauda (Saunders, 1925) well developed and erect as shown in Fig. 9. Anal pseudopod consisting of the usual fine spines, long lanceolate setae, and shorter, broader, saw-toothed setae as shown in Fig. 10. The number of these setae is difficult to determine and appears to vary from specimen to specimen. Anal gills simple.

Types.—Tzaneen, N. Transvaal, South Africa: Holotype ♂ (in SAIMR) with its pupal exuviae on same slide. Paratypes, 5 ♂, 1 with larval and pupal exuviae and 4 with pupal exuviae only; 3 ♀, 1 with larval and pupal exuviae and 2 with pupal exuviae only. In addition: 2 ♂ with pupal exuviae on the same slide; 1 ♀ pupa, 2 ♂ and 1 ♀ pupae on the same slide, 1 immature pupa, 1 larval exuviae; 5 larvae on 1 slide and 3 on another. All material collected in leaf axils of *Colocasia* by B. de Meillon, 1976. (1 ♂, 1 ♀ paratypes deposited in USNM).

Tafo, Ghana: 26 ♂, 22 ♀, 1 pupa, 14 pupal exuviae, 2 larvae, from leaf axils of aroid, lily, and *Musa*, collected by L. G. Saunders 15.iv.1963. The association of the larvae with the pupal exuviae and the adults is not certain. (USNM).

#### THE OLIGARTHRA GROUP

Four species have been described in which the female has 2 spermathecae and the antenna is 11-segmented: *bacoti*, *brevis*, *nicopina*, and *oligarthra*.

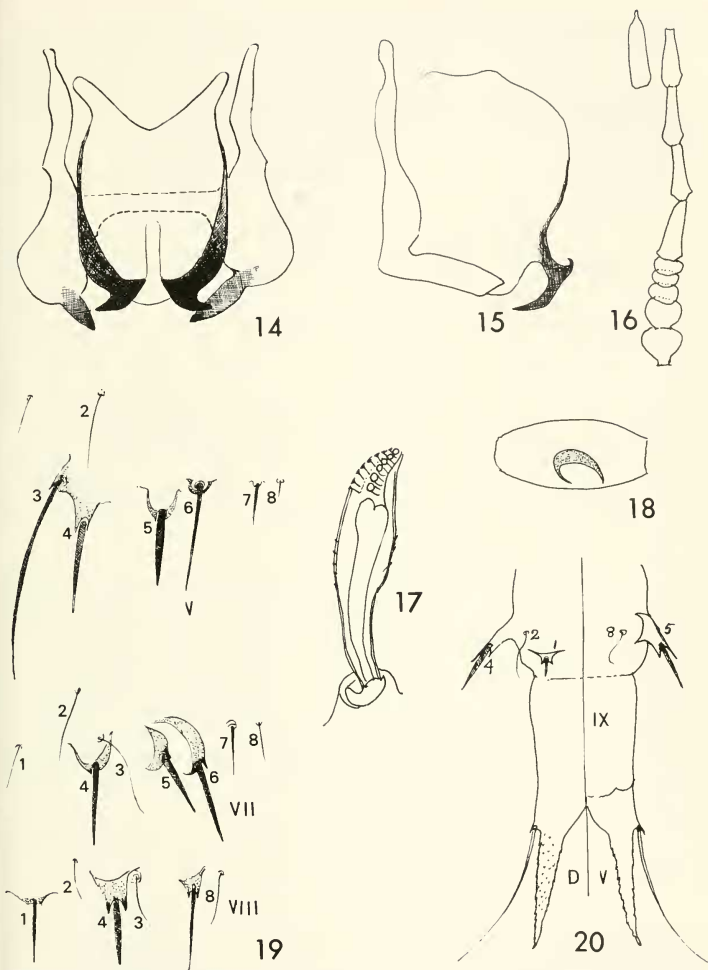
#### KEY TO SPECIES OF THE OLIGARTHRA GROUP

1. Paramere of male genitalia drawn out distally at more or less right angles to a spinelike sclerotized point (Figs. 11, 15) ..... *bacoti* (Ingram and Macfie)
- Paramere pale, broad, and not spinelike distally ..... 2
2. Third palpal segment with a deep sensory pit; anal gills of larva forked ..... *oligarthra* Saunders
- Third palpal segment with pit shallow; anal gills long and simple (paucity of material does not allow separation of these species) ...  
..... *brevis* (Johannsen)  
..... *nicopina* Chan and LeRoux

*Forcipomyia* (*Phytohelea*) *bacoti* (Ingram and Macfie)

Figs. 14–20

*Apelma bacoti* Ingram and Macfie, 1923:55 (♂; Sierra Leone; fig. wing, genitalia).



Figs. 14-20. *Forcipomyia bacoti*. 14, Male aedeagus of lectotype, ventral view. 15, Male aedeagus and parameres of a Ghana specimen, side view. 16, Antenna of a female from Ghana. 17, Pupal respiratory horn of a specimen from Ghana. 18, Third palpal segment of a female from Ghana. 19, Tubercles, spines, and setae of a pupa from Zululand. 20, Abdominal segments VIII and IX of a pupa from Ghana, dorsal left, ventral right.

*Lasiohelea natalia* de Meillon, 1936:158 (♂, ♀, pupa; Zululand; figs.). NEW SYNONYMY.

Types.—Syntypes of *bacoti*, 3 ♂, Freetown, Sierra Leone, 1915, A. Bacot, "reared from larvae found in leaf axils of "cocked-hat" tree (*Dracaena* sp.)" (BMNH). Holotype ♂, of *natalia*, Eshowe, Zululand, iii.1935, B. de Meillon; 4 ♂ and 3 ♀ paratypes, same data (SAIMR).

Thanks to the cooperation of the trustees of the British Museum (Natural History) it has been possible to examine and remount a male syntype of *F. bacoti*. A holotype has apparently never been selected or labelled as such, so at the suggestion of Richard Lane (BMNH) the male syntype mentioned above is here selected as the LECTOTYPE. It bears the following 4 original labels: (1) *Apelma bacoti*; (2) Cotype; (3) Sierra Leone, Freetown, A. Bacot 1915-356; (4) Larvae in leaf axil of "cocked hat tree. *Dracaena* sp." This last is in what can be recognized as the handwriting of the late F. W. Edwards. Paratype material of *F. natalia* was made available by the Director, South African Institute for Medical Research (SAIMR). In addition we have the collection made by L. G. Saunders in Ghana during 1963 which is now deposited in the National Museum of Natural History (USNM) in Washington. As a result of remounting the male genitalia of the specimen selected as the lectotype of *bacoti*, and finding nothing to the contrary in other characters, the above synonymy became evident.

Macfie (1939) described from Uganda what he thought to be the female of *F. bacoti* from a specimen with a single spermatheca. He regarded two spermathecae and the reduced female antenna of *natalia* as being abnormal. Macfie's female is definitely not *bacoti* but belongs in the *comis* Group and cannot be differentiated with any certainty from *F. tzaaneensis*. One of Macfie's slides shows a female with two spermathecae and the reduced antenna of the *oligarthra* group. Why he chose to assign the specimen with the single spermatheca and the 15-segmented antenna to *bacoti* is puzzling.

As a result of the new synonymy, however, the female and pupa of *bacoti* are known from their description under *natalia*. We are now able to correct and supplement the description of *bacoti*. The male genitalia of the lectotype are described and figured (Figs. 14, 15) and a fuller account with figures is given of the pupa and the female (Figs. 16-20).

Male.—Wing length from basal arculus 0.95-1.10 mm (8 ♂).

*Head*: In some otherwise normal specimens the sensory pit on the 3rd palpal segment is quite deep; this is unfortunate as the depth of this organ is usually regarded as of specific importance. Antennal ratio (III-XI/XII-XV) varies from 1.0 to 1.2 in specimens from all sources. There is, however, some variation in the mean relative lengths of XII-XV as follows (in parentheses, the number examined): Lectotype and 1 other 100-106-86-96 (2); Ghana 100-110-93-100 (7); Eshowe, Zululand 100-100-100-125 (2).

*Thorax:* Costa reaching to about middle of wing in all specimens. Legs with tarsal ratios of front, middle, and hind legs respectively 2.3–3.0, 2.1–2.8, and 2.6–3.1.

*Abdomen:* Genitalia (Figs. 14, 15) drawn from the lectotype and a Ghana specimen; the pair of sclerotized hooks at tip of aedeagus quite apparent; parameres sclerotized apically and drawn to a strong pointed process which is especially noticeable in side view.

Female.—Wing length measured from arculus 0.8–0.9 mm; description based on 5 specimens. General coloration as in the male.

*Head:* Eyes and palpus (Fig. 3a) as in ♂ but sensory pit deeper (Fig. 18). Antenna (Fig. 16) 11-segmented; according to Saunders (1956) the 1st segment after the 2nd represents the amalgamation of III–VII and this is acceptable; antennal ratio (III–X/XI–XV) 0.3–0.4; segments XI–XV with relative lengths 3.0–4.0, 3.5–7.5, 3.5–7.5, 3.0–3.5, 4.0–5.0 (including the nipple on XV).

*Thorax:* Coloration as in the ♂ but perhaps more pronounced. Wing with costa extending to middle of wing in all specimens; 1st radial cell not apparent, even in stained specimens, 2nd radial cell well formed. Legs with ratios of 1st to 2nd tarsomeres of front, middle, and hind legs respectively, 2.5–2.7, 2.7–2.8, and 2.8–3.0; claws small, simple, slightly curved; empodium well developed.

*Abdomen:* Spermathecae 2, one slightly larger than the other; moderately well sclerotized, measuring 0.062 by 0.050 mm and 0.056 by 0.044 mm.

*Pupa.*—The following description is based on a specimen from Ghana from which a typical male was dissected and from several pupal exuviae of "natalia" from Eshowe. Pupal exuviae generally brown, especially those from Zululand. Respiratory horn (Fig. 4) 0.15 mm long by 0.05 mm greatest breadth; with few imbrications and with 14 spiracular openings at the tip.

*Abdomen* (Figs. 19, 20): Seta I–V a small delicate hair; seta 2-V rather similar and difficult to find; seta 3-V a long, strong seta placed on a single tubercle with 4-V;  $t_1$  minute or absent,  $t_2$  absent; setae 5-V and 6-V separated; seta 7-V smaller but stiff and spinelike; seta 8-V a delicate hair. On segment VIII seta 3-VIII minute or absent; seta 3-VII a long delicate hair; seta 3-VI well developed as in 3-V. Segment IX with caudal rami about as long as segment; caudal setae reaching beyond tip of the rami.

*Specimens examined.*—GHANA: Tafo, 15.iv.1963, L. G. Saunders, from *Musa*, pineapple, and lily leaf axils, 16 ♂, 5 ♀, larvae, pupae (USNM). NATAL: Eshowe, Zululand, 1935, B. de Meillon, from hole in a tree fern, 2 ♂, 10 pupal exuviae (SAIMR). SIERRA LEONE: Freetown, 1915-356, A. Bacot, larva in leaf axils of "cocked hat tree" (*Dracaena* sp.), 1 ♂ (selected here as LECTOTYPE) (BMNH). UGANDA: Kampala, viii.1931, E. G.

Gibbins, 3 ♂, 5 ♀ (BMNH). Fort Portal, 25.ix.1931, E. G. Gibbins, 4 ♂ (BMNH).

*Forcipomyia (Phytohelea) brevis* (Johannsen)

*Apelma brevis* Johannsen, 1927:205 (all stages; Hawaii; on pineapples); Illingworth, 1934:542 (figures all stages; life history; on pineapples); Williams, 1944:172 (notes; Hawaii).

*Forcipomyia (Trichohelea) brevis* (Johannsen); Hardy, 1960:179 (re-described; Hawaii; figs.).

Types.—Holotype ♂, allotype ♀, Waipahu, Oahu, 7-8-27, J. P. Illingworth, ex pineapple leaf sheath (Type no. 75308, USNM). Paratypes, all stages, in USNM and CU.

Specimens examined.—HAWAII: Kunia, Oahu, 1.x.1945, 18th Laboratory, W. W. Wirth, light trap, 1 ♀ (USNM). Schofield Barracks, Oahu, 10.xi.1945, W. W. Wirth, light trap, 1 ♀ (USNM). Waipahu, 7-8-27, J. P. Illingworth, holotype and allotype (pinned, USNM); 1 ♂, 1 ♀ (pinned), 3 ♂, 2 ♀, 2 larvae, 2 pupae (slides) (CU). NEW YORK: In pineapple (Plant Quarantine) from Hawaii, xii.1968, 2 larvae, 2 pupae (USNM).

*Forcipomyia (Phytohelea) nicopina* Chan and LeRoux

*Forcipomyia (Trichohelea) nicopina* Chan and LeRoux, 1971:754 (all stages; Singapore; figs.).

Types.—Holotype, fourth-instar larva, Wallace Way, Singapore, v.1962, K. L. Chan, in watery detritus in apical leaf axils of pineapple plants (in Lyman Entomological Museum, Macdonald College, Quebec). Paratypes, 2 larvae, 3 pupae, 2 ♀, 9 ♂, and 31 associated pupal exuviae, same data (in Chan collection).

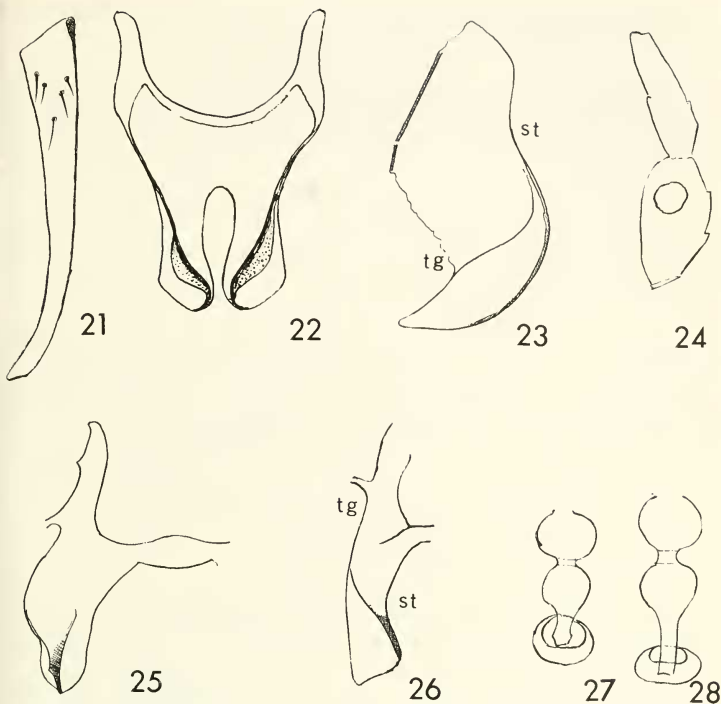
Specimens examined.—SINGAPORE: Wallace Way, ix.1961, K. L. Chan, in water in axils of pineapple plant, 1 ♂, 2 ♀ (topotypes, USNM).

Discussion.—We cannot separate this species from *F. brevis* on the basis of our rather inadequate material. From the descriptions, the larvae may be separated by the yellow-brown head and 3-branched anal blood gills in *nicopina*, and the whitish head and simple (unbranched) anal blood gills in *brevis*.

*Forcipomyia (Phytohelea) oligarthra* Saunders

*Forcipomyia (Trichohelea) oligarthra* Saunders, 1956:698 (all stages; Puerto Rico; figs.); Tokunaga and Murachi, 1959:209 (re-described; Caroline Islands; fig. female); Tokunaga, 1961:115 (all stages; New Britain; figs.; larvae in axils of cultivated banana).

Types.—Holotype ♀, allotype ♂, Corcega Beach, Puerto Rico, 22.ii.1953, L. G. Saunders, reared from larvae in leaf axils of terrestrial bromeliads, *Bromelia pinguin* L. (deposited in Canadian National Collection, Ottawa).



Figs. 21-26. *Forcipomyia dominicana*. 21, Male dististyle. 22, Male aedeagus, ventral view. 23, Male aedeagus, lateral view (*st*, sternal side; *tg*, tergal side). 24, Palpal segments III-V of female. 25, Male paramere of one side, ventral view. 26, Male paramere in side view. Figs. 27-28. Antennal segments II-IV of female. 27, *F. tzaneensis*. 28, *F. dominicana*.

Paratypes, many, all stages, Puerto Rico, Montserrat, Dominica, Guyana, from pineapple.

Specimens examined.—FLORIDA: Sebring, 15-27.xi.1927, M. R. Osburn and M. DuPree, pineapple plants, 1 ♂, 1 ♀ (USNM). PUERTO RICO: San Juan, 25.vi.1962, L. G. Saunders, in pineapple, 6 ♂, 5 ♀ (USNM). SINGAPORE: 1.x.1952, D. H. Colless, pineapple leaf axils, 2 ♂, 2 pupal exuviae, 1 larva (USNM).

Note.—Saunders (1956) recorded *oligarthra* from British West Indies, Guyana, Mexico, and Cuba. Tokunaga (1961) reported the species from



New Britain in leaf axils of banana. Tokunaga and Murachi (1959) also recorded it from Palau in Micronesia.

#### THE *BROMELICOLA* GROUP

The species belonging to this group in which the females have two spermathecae and 15-segmented antennae are *antiguensis*, *belkini*, *bromelicola*, *caribbeana*, *crinume*, *dominicana*, *edwardsi*, *jocosa*, *magna*, and *marksae*.

#### KEY TO SPECIES OF THE *BROMELICOLA* GROUP

1. Male with well-developed empodium ..... 2
  - Male with empodium reduced to a single thread or absent ..... 3
2. Hind tarsal ratio 2.0; female palpal segments IV and V completely fused; pupa with a spherical, spinose tubercle on operculum .....
  - ..... *jocosa* Saunders
  - Hind tarsal ratio near 3.0; female palpal segments IV and V partly or wholly separated; pupa without such tubercle . *crinume* (Tokunaga)
3. Hind tarsal ratio 2.0; pupa with caudal setae  $\frac{1}{2}$  as long again as the rami; larva with lateral setae arising from papillae .....
  - ..... *antiguensis* Saunders
  - Hind tarsal ratio larger; pupa with caudal setae shorter than or about as long as the rami; lateral setae of larva not on papillae ..... 4
4. Lateral setae of larva finned; pupal respiratory horn expanded before apex; spermatheca without sclerotized neck ..... 5
  - Lateral setae of larva unmodified; respiratory horn of pupa not expanded; spermatheca with slender sclerotized neck (except in *bromelicola*) ..... 6
5. Sensory pit of female palpus shallow, depth less than diameter of opening ..... *caribbeana* Saunders
  - Sensory pit of female palpus deep, depth equal to or more than diameter of opening .....
 

}	<i>magna</i> (Saunders) <sup>2</sup>
}	<i>edwardsi</i> (Saunders)
6. Sensory pit of female palpus deep (see couplet 5) ..... 7
  - Sensory pit of female palpus shallow ..... 8
7. Male aedeagus with apical pair of slender, sclerotized hooks; pupal respiratory organ with 20-25 spiracular openings; pupal caudal rami long, 1.3 $\times$  as long as base of segment IX ..... *marksae* Tokunaga

<sup>2</sup> Material at hand does not permit the separation of these two species. Saunders (1925) gives the size of the spermathecae of *edwardsi* as 0.053 by 0.041 mm, but in 4 specimens, including syntypes, measured by us the mean size of the larger spermatheca was 0.081 by 0.067 mm (range 0.075-0.088 by 0.062-0.081 mm). The spermathecae of *magna* are even larger, measuring 0.094 by 0.081 mm and 0.088 by 0.069 mm. If these differences in size are stable they will allow separation of the two species.

- Male aedeagus with apical pair of broadly rounded lobes; pupal respiratory organ with 15 spiracular openings; pupal caudal rami short, 0.8× as long as base of segment IX ..... *belkini*, new species
- 8. Female palpus with sensory pit located in middle of 3rd segment; female spermathecae without sclerotized necks; pupa with caudal rami stout and as long as or shorter than base of segment IX ..... *bromelicola* (Lutz)
- Female palpus with sensory pit located at distal 0.7 of 3rd segment; female spermathecae with slender sclerotized necks; pupa with caudal rami attenuated, slightly longer than base of segment IX ..... *dominicana*, new species

*Forcipomyia (Phytohelea) antiguensis* Saunders

*Forcipomyia (Trichohelea) antiguensis* Saunders, 1956:700 (all stages; Antigua; figs.).

Types.—Holotype ♀, allotype ♂, Falmouth Harbour, Antigua, B.W.I., 2.v.1953, L. G. Saunders, reared from larvae in epiphytic bromeliads (in Canadian National Collection, Ottawa).

Specimens examined.—None available.

*Forcipomyia (Phytohelea) dominicana* de Meillon and Wirth,

NEW SPECIES

Figs. 21–26, 28–33

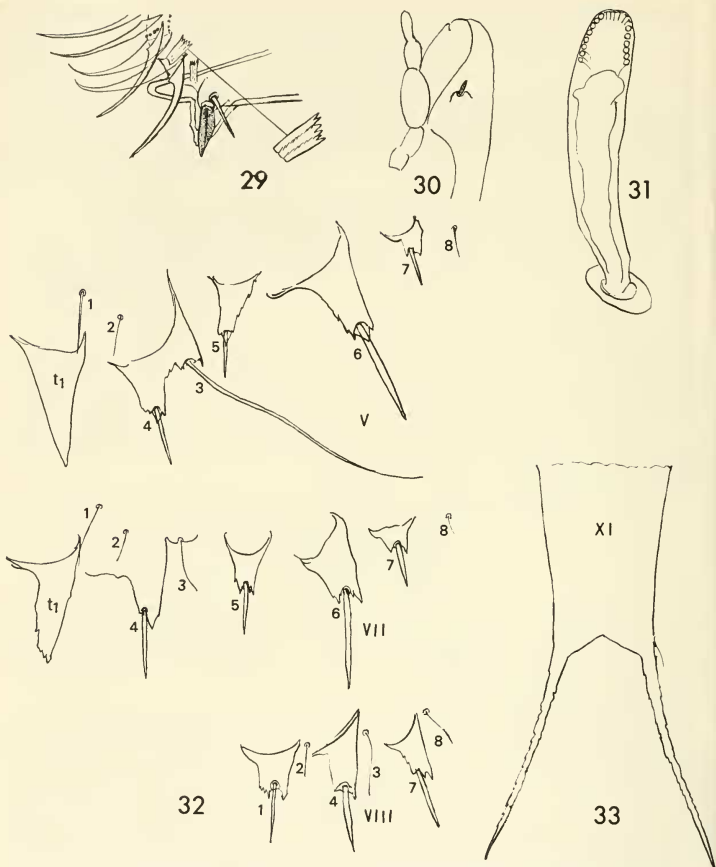
In general appearance as in most species of the subgenus, that is, dark brown with paler legs and no striking markings anywhere. The description is from the holotype; any differences worth mentioning are in parentheses and relate to 1 other specimen.

Male.—Wing length measured from the basal arculus 0.9 mm.

*Head*: Eyes narrowly separated, bare. Palpus with relative lengths of segments II–V as 20-40-25-25; segments IV and V partially fused; 3rd segment with a large sensory pit on distal ½ of segment as in ♀. Antenna with unusually long neck on segment III; IV–IX about as long as wide, X and XI slightly longer; relative lengths of XII–XV as 70-60-50-65 (70 in paratype); antennal ratio (III–XI/XII–XV) 1.1.

*Thorax*: Wing with ratio of costal length to wing length 0.5; radial cells, if present, not visible due to excessive clearing. Tarsal ratios of front, middle, and hind legs as 2.7, 2.7, 2.25; claws only slightly curved; empodium absent.

*Abdomen*: Genitalia (Figs. 21–23, 25–26) described from the dissected and stained genitalia of the paratype; basistyle as usual in the subgenus, parallel sided and about 3× as long as wide; dististyle (Fig. 21) slightly shorter, rather slender and only slightly wider basally; aedeagus (Fig. 22) shield-



Figs. 29-33. *Forcipomyia dominicana*. 29, Dorso-apical angle of anal segment of larva. 30, Clypeal plate of pupa in side view showing short, stout spines. 31, Respiratory horn of pupa. 32, Pupa, tubercles, and setae of abdominal segments V, VII, and VIII. 33, Pupa, segment IX and rami.

shaped, not strongly sclerotized, divided apically into 2 slightly expanded lobes, in side view each lobe seen to project dorsally to an unsclerotized point, the only sclerotization occurring apically on the ventral face as shown in figure; parameres unsclerotized except ventrally as shown (Figs. 23, 25).

Female.—Wing length 1.0 mm. Described from 2 paratypes, one of which has its associated pupal exuviae.

*Head:* Eyes as in ♂. Palpus (Fig. 24) with relative lengths of segments II–V as 25-40-25-20; IV and V partly fused and III with a large but shallow sensory pit on distal ½ of segment. Antenna with an unusually long neck on segment III; segments IV–VII rather broadly joined as described by Tokunaga (1961) for *marksae*; antennal ratio (III–X/XI–XV) 0.4; relative lengths of XI–XV as 25-25-25-25-35 including terminal nipple.

*Thorax:* Wing with costa reaching to middle; 2nd radial cell apparently open. Legs with tarsal ratios of front, middle, and hind legs respectively 3.0, 2.4, 2.75 (the higher ratio of 3.0 in the front leg in both specimens is unusual); claws only slightly curved; empodium well developed.

*Abdomen:* Spermathecae 2, pyriform; measuring (with a short sclerotized neck excluded) 0.056 by 0.044 mm and 0.050 by 0.047 mm in 1 female, and 0.062 by 0.050 mm and 0.056 by 0.050 mm in the other; as usual in the subgenus the genital sclerotizations are ill defined.

*Pupa.*—Described from 2 exuviae on 2 slides, each with its corresponding adult. Pale (in our experience the color of the pupal exuviae is a variable character) with some very minor shagreening on the operculum. Respiratory horn (Fig. 31) clear yellowish without any spicules, 20 spiracular openings present apically. Clypeal plate (Fig. 30) with a pair of very stout but short spines (which in other species appear as a pair of very fine delicate (and often minute) hairs). Abdomen (Figs. 32, 33) with segment IX bearing a pair of very long, attenuated caudal rami, caudal setae minute and difficult to locate; segment VIII with normal setation but tubercles much enlarged; VII with normal setation but *t*<sub>1</sub> greatly enlarged, *t*<sub>2</sub> absent or unapparent; V as in VII but seta 3 greatly elongated and placed on the same basal tubercle as 4, *t*<sub>1</sub> greatly enlarged, *t*<sub>2</sub> absent.

*Larva.*—Described from 3 whole larvae presumed to be those of *dominicana*. Head a little longer than broad. Thorax of normal appearance and this includes the thoracic pseudopod. Abdomen with setae all fine, unmodified, and reduced in size; setae of dorsal plate on VIII shorter than the elongated anal segment, lateral setae unmodified; 2 pairs of dorso-apical setae, the more lateral one a short, thick, stout spine, the other near the dorsal margin and short, greatly expanded, bladelike (Fig. 29). Pseudopod truncate (as previously described for *comis*, *crinume*, *jocosa*, and *belkini*); the spines surrounding the pad all more or less similar, narrow and with or without very fine teeth; combs present.

*Types.*—Holotype ♂, Dominica, W.I., Calibishie, 16.iii.1965, W. W. Wirth, reared from *Heliconia* sp. (Type no. 75306, USNM). Paratypes, 1 ♂, 1 ♀, 2 ♀ with associated pupal exuviae, 3 pupae, and 3 larvae (USNM), same data.

*Remarks.*—This species is undoubtedly closely related to *marksae* but

separable therefrom as shown in the key. It is of interest to note that *Heliconia* is indigenous to New Britain where *marksae* was found in *Alocasia* and *Colocasia*.

*Forcipomyia (Phytohelea) belkini* de Meillon and Wirth,

NEW SPECIES

Figs. 34-41, 45-46

A member of the *bromelicola* Group sharing with *edwardsi*, *fijiensis*, and *marksae* a deep sensory pit on the 3rd palpal segment. The female of *fijiensis* is unknown, but the species probably belongs here and differs from *belkini* significantly in palpal and genital characters (Figs. 42-44). The larger than usual 2nd palpal segment and deep sensory pit of *belkini* is reminiscent of *sabroskyi* which is also known only in the male adult; but here again the male genitalia differ markedly from the description given by that author.

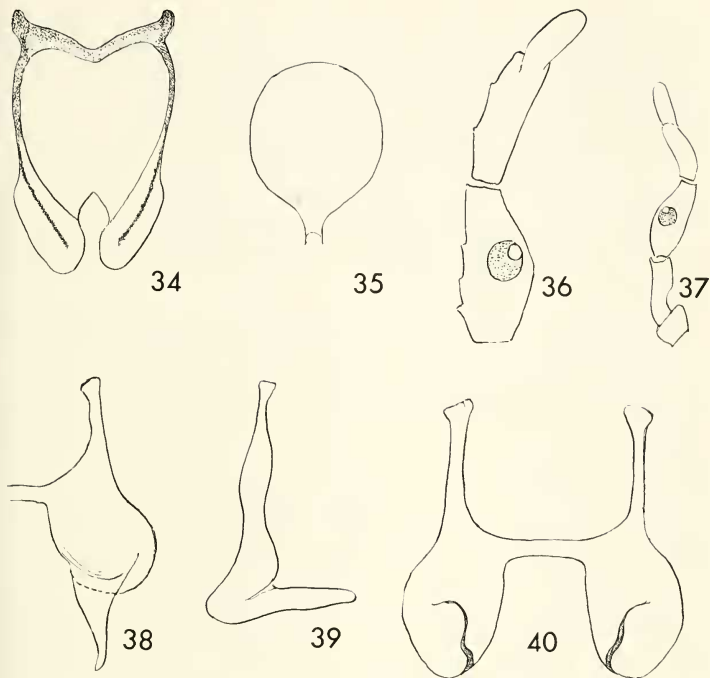
The description of *F. belkini* is from slide material in the National Museum of Natural History. The adults are brown with pleuron slightly paler anteriorly; the abdominal sterna are markedly pale and contrast sharply with the terga; scutellum and legs pale.

Male.—The description is from the holotype with figures in parentheses taken from 8 other ♂. Wing length measured from the basal arculus 0.9 mm (0.85-1.00).

*Head*: Eyes narrowly separated in front, bare. Palpus (Fig. 37) longer than proboscis; 3rd segment slightly swollen in middle, sensory pit deep, circular, sclerotized and with a small opening; segments IV and V partly fused; segment II longer than usual; relative lengths of segments II-V in proportion of 20-30-40-50 (15-20, 30, 40-50, 50-60). Antenna with relative lengths of segments XII-XV including terminal papilla as 50 (50-60), 60 (60-70), 55 (50-60), 65 (60-75); segments IV-XI mostly about as wide as long; antennal ratio (III-XI/XII/XV) 1.0.

*Thorax*: Scutum brown with shoulders and pleuron a shade paler, scutellum pale; postnotum dark. Wing as usual in the subgenus; costa 0.48 (0.47-0.50) of wing length. Legs with femora and tibiae brown, tarsi a shade paler; ratios of 1st and 2nd tarsomeres of front, middle, and hind legs 2.3 (1.9-2.3), 1.9 (1.9-2.3), 2.4 (2.2-2.5); empodium undeveloped; claws slightly curved.

*Abdomen*: Brown above, pale below. Genitalia (Figs. 34, 38-40) with aedeagus (Fig. 34) shield shaped, borders sclerotized, apex with 2 lobes separated by a deep cleft; in situ and without undue pressure each paramere appears to consist of a bulbous lobe but when dissected it is seen in side view to have a long, strong, pointed process directed ventrally (Fig. 38); when pressure is applied to paramere its process appears as in Fig. 40; basistyle, dististyle, tergum, and sternum as usual in the subgenus.



Figs. 34-40. *Forcipomyia belkini*. 34, Male aedeagus, ventral view. 35, Female spermatheca (one of two). 36, Female palpus, segments III-V. 37, Male palpus (not to same scale as Fig. 36). 38, Male paramere of one side, slightly crushed and flattened. 39, Male paramere in side view. 40, Male parameres, ventral view, in natural position.

Female.—Described from 2 paratype specimens; coloration as in ♂. Wing length measured from the arculus 0.8 mm.

*Head*: As in ♂. Palpus (Fig. 36) with segments IV and V partly fused; III distinctly swollen in middle, with characteristic deep sensory pit, the size of the opening to the pit appearing to be variable. Antenna with segments IV-X transverse, slightly wider than long; XI-XIV subequal, each measuring about 30 units, XV including the nipple just over 50 units; ratio of III-X/XI-XV 0.7.

*Thorax*: Wing with costa ending at the middle; nature of the radial cells could not be determined precisely but they appear to be typical of the subgenus. Legs with ratios of 1st and 2nd tarsomeres of front, middle, and hind



legs as 2.6, 2.0–2.5, and 2.7; claws short, moderately curved; empodium present.

*Abdomen:* Spermathecae (Fig. 35) 2, pyriform, with a short length of the duct sclerotized; including the duct measuring 0.056–0.063 mm by 0.044–0.047 mm in the 2 specimens.

*Note.*—The immature stages associated with the adults and from the same habitat are 2 larvae and 2 male pupae; 1 larva, 1 male pupa, and 3 pupal exuviae; and 2 larvae and 1 female pupa, on 3 slides. The presence of the male pupa makes the association definite for this sex. The female pupa unfortunately has the terminal segment missing, but the spermathecae and what can be seen of the palpus leave little room for doubt that it is also the same species.

*Pupa.*—Pupal skin pale in color without imbrications or nodules of any note. Respiratory horn of the usual shape for the subgenus, measuring 0.17 mm long and 0.04 mm in greatest breadth; 15 spiracular openings in a horse-shoe formation; not heavily imbricated but a shade darker than the rest of the pupa. Clypeal plate with a pair of minute, delicate hairs as usual in the subgenus and in sharp contrast to those of *dominicana* n. sp. Abdomen (Figs. 45–56) with  $t_1$  greatly enlarged on segments III–VII,  $t_2$  absent; spine 1 on VIII subterminal on a large tubercle; seta 3 on VIII unusually long and well developed; seta 8 on III–VIII a long delicate hair; seta 2 on VII–VIII minute; seta 1 on III–VII about the same, short and stiff; segment IX with relatively short caudal rami, the setae shorter than the rami.

*Larva.*—There are 5 larvae which under the circumstances may safely be regarded as belonging to the species. Head light brown and about same color as body; slightly longer than broad; setae all very small, delicate and hard to find. Prothoracic pseudopod not very different from that of *bro-melicola*. Abdomen with the usual dorsal and lateral setae which are shorter than the width of the body, delicate, inconspicuous, and unmodified; dorsal sclerotized plate on posterior margin of penultimate segment with a pair of strong, dark, curved setae shorter than the segment itself; anal segment only slightly shorter than penultimate, with lateral setae unmodified, short and fine; cauda upturned as figured, 1 pair of dorsal setae short and stout, flattened with a few serrations near the apex or none; posterior pseudopod (Fig. 41) truncate and provided with peripheral combs between the setae as in *dominicana* and some others.

*Types.*—Holotype ♂, paratypes 8 ♂, 2 ♀, 7 larvae, 4 male pupae, 2 female pupae, 3 pupal exuviae, all labelled: New Zealand, Amwaniwa Falls, Gisborne Province, Dist. Nat. Park near Urewera, 27.xii.1963, Belkin and Schroeder, ex leaf axil of *Cordyline australis* Hooker in Podocarp-beech forest (Type no. 75307, USNM).

*Discussion.*—The species is named for Professor John A. Belkin, University of California in Los Angeles, in appreciation of his interest in the collection and study of ceratopogonid midges.

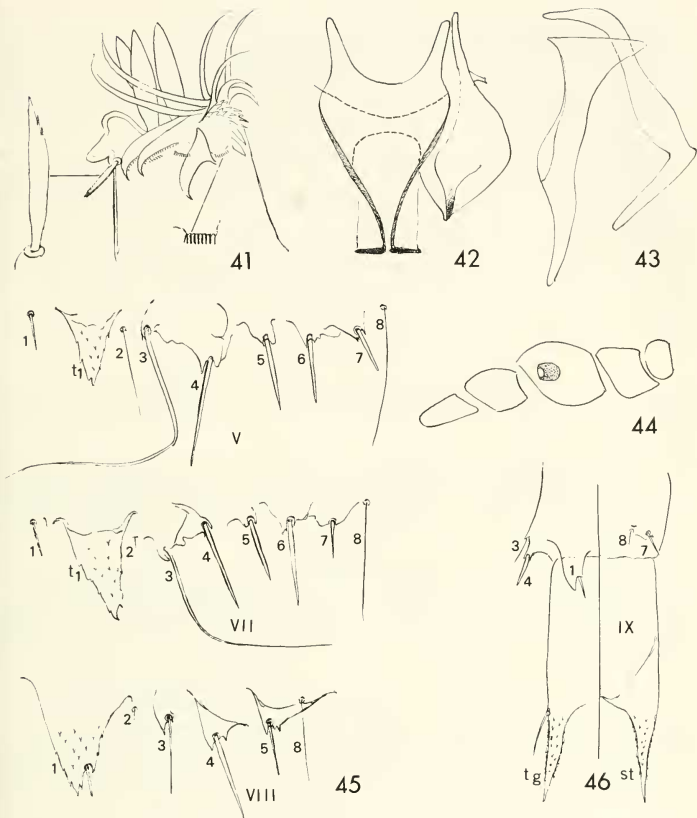


Fig. 41. *Forcipomyia belkini*, posterior end of larva in side view. Figs. 42-44. *F. fijiensis*. 42, Male aedeagus and one paramere of holotype, ventral view. 43, Male aedeagus and paramere in side view. 44, Male holotype, palpus. Figs. 45-46. *F. belkini*. 45, Pupa, setae, and tubercles of abdominal segments V, VII, and VIII. 46, Pupa, segments VIII and IX, dorsal left, ventral right.

*Forcipomyia (Phytohelea) bromelicola* (Lutz)

- Ceratopogon bromelicola* Lutz, 1914:84 (♀; Brazil; fig. wing).
- Apelma bromelicola* (Lutz); Saunders, 1925:263 (combination; all stages re-described; figs.; Brazil).
- Lasiohelea bromelicola* (Lutz); Floch and Abonnenc, 1942:2 (French Guiana; combination; re-described; fig. wing, palpus, tarsus); Lane,

1945:360 (♂, ♀ redescribed from Lutz' types; Brazil); Cavalieri, 1962:360 (comparative notes).

*Forcipomyia (Phytohelea) bromelicola* (Lutz); Wirth, 1974:9 (combination).

Types.—Lectotype ♂ (designated by Lane, 1945), Ilha do Governador, Rio de Janeiro, Brazil, A. Lutz, reared from bromeliads (on pin; in Instituto Oswaldo Cruz). Allotype ♀, same data, on slide.

Specimens examined.—BRAZIL: Rio de Janeiro, 23.vii.1923, L. G. Saunders, from small bromeliads on rocks in Rio Bay, 1 ♂, 1 larva (BMNH). TRINIDAD: Tabaquite, Charuma Forest, iv,v.1955, T. H. G. Aitken, ex bromeliad *Aechmea nudicaulis* Grisebach, 1 ♂, 1 pupa (USNM).

Notes.—Saunders' excellent redescription and figures were made from material he collected in Rio Bay and compared by him with two males and one female types from the Lutz collection.

*Forcipomyia (Phytohelea) caribbeana* Saunders

*Forcipomyia (Trichohelea) caribbeana* Saunders, 1956:696 (all stages; Trinidad; figs.).

Types.—Holotype ♀, allotype ♂, Mount St. Benedict, Trinidad, 12.v.1953, L. G. Saunders, reared from larvae in fallen epiphytic bromeliad in forest (Canadian National Collection). Paratypes, all stages, from Trinidad, Guyana, Tobago (Saunders collection).

Specimens examined.—BRAZIL: Bahia, Ilhéus, CEPEC, 8.iv.1977, D. Fish and S. Soria, reared from leaf axils of bromeliad, 3 ♂, 4 ♀, 4 larvae, 3 pupae. GUYANA: Georgetown, 20.v.1953, L. G. Saunders, 1 ♀, 1 pupal exuviae, 3 larvae, all marked "paratype" (USNM).

*Forcipomyia (Phytohelea) crinume* (Tokunaga)

*Dasyhelea crinume* Tokunaga, 1932:1 (all stages; Japan; figs.).

*Forcipomyia crinume* (Tokunaga); Tokunaga, 1934:469 (larva, pupa redescribed; figs.; combination); Saunders, 1956:704 (compared with *jocosa*).

Types.—Holotype ♂, allotype ♀, paratypes (in alcohol), Setto, Wakayama Prefecture, Japan, 17.vi.1930, M. Tokunaga, reared from rainwater between the leaves of *Crinum* lilies along seashore (deposited in Entomological Laboratory, Kyoto Prefectural University, Japan).

Specimens examined.—None available.

*Forcipomyia (Phytohelea) edwardsi* (Saunders)

*Apelma edwardsi* Saunders, 1925:260 (all stages; Brazil; figs.).

*Forcipomyia (Trichohelea) edwardsi* (Saunders); Saunders, 1956:698 (combination; compared with *caribbeana*).

Types.—Syntypes, numerous examples of all stages, from small brome-

liads on rocks in Río Bay and on Island of Paquetá, Brazil, 23.viii.1923; also in terrestrial bromeliads in woods behind Pernambuco (Dois Irmãos), Brazil, 10.ix.1923, L. G. Saunders (BMNH).

Specimens examined.—BRAZIL: Río and Pernambuco, viii,ix.1923, L. G. Saunders, in terrestrial bromeliads, 1 ♂, 4 ♀, 4 pupal exuviae, 3 larvae, labelled "cotypes" (BMNH). TRINIDAD: No locality, ix.1963, R. W. Williams, from bromeliad *Guzmania* sp., 1 ♂, 6 ♀ (USNM).

Notes.—This species is quite similar to *F. caribbeana* and *magna*. In *caribbeana* the larval head is shorter (1.45× as long as broad) and the sensilla of the female palpus are not borne in a pit; while in *edwardsi* the larval head ratio is 1.70 and the palpal sensilla are borne in a deep pit. *Forcipomyia magna* differs from *edwardsi* most notably in its larger size (wing length 1.24 mm compared with 1.0).

*Forcipomyia (Phytohelea) jocosa* Saunders

*Forcipomyia (Trichohelea) jocosa* Saunders, 1956:701 (all stages; Trinidad; figs.).

Types.—Holotype ♀, allotype ♂, Mount St. Benedict, Trinidad, 13.v.1953, L. G. Saunders, reared from terrestrial *Bromelia pinguin* L. (in Canadian National Collection). Paratypes, 1 ♂, 7 ♀, 6 larvae, 2 pupae, same data.

Specimens examined.—None available.

Notes.—This species resembles *comis* in the truncate structure of the tail end of the larva, but *comis* has a normal cauda flanked by the usual bladeliike chaetae, while in *jocosa* the tail end is squarely truncate, forming a terminal disc rimmed with four pairs of comblike plates projecting outwards, one pair of lateroventral papillate prominences, and one median ventral pad or cushion bearing symmetrically disposed black studs. In the larva of *crinume* the cauda is still larger and "pineapple-like"; the ventral studded pad is tightly packed with rounded papillae, but the disc is not rimmed with combs.

*Forcipomyia (Phytohelea) magna* (Saunders)

*Apelma magna* Saunders, 1925:266 (all stages; Brazil; figs.).

*Forcipomyia (Trichohelea) magna* (Saunders); Saunders, 1956:701 (combination; compared with *antiguensis*).

Types.—Syntypes, 4 larvae, 4 pupae, 2 ♂, 1 ♀ (alcohol), from terrestrial bromeliads in woods behind Pernambuco (Dois Irmãos), Brazil, ix.1923, L. G. Saunders (BMNH).

Specimens examined.—BRAZIL: Pernambuco, 10.ix.1923, L. G. Saunders, from bromeliads, 1 ♀, 2 pupal exuviae, 2 larvae, labelled "cotypes" (Saunders collection in USNM); 1 ♂, larval head, and pupal exuviae (BMNH).

*Forcipomyia (Phytohelea) marksae* Tokunaga

*Forcipomyia (Trichohelea) marksae* Tokunaga, 1961:117 (all stages; New Guinea; figs.).

Types.—Holotype ♀, allotype (sic) ♀, paratypes, 5 ♀, 2 ♂, Subitana, Port Moresby, New Guinea, 3.iv.1958 (Casey) (deposited in Bishop Museum, University of Queensland, and Kyoto Prefectural University, Japan).

Specimens examined.—NEW SOUTH WALES: Tilba Tilba, 14.xii.1953, B. McMillan, bred from *Alocasia*, 2 ♂, 4 ♀, 2 larvae, 3 pupae (USNM). QUEENSLAND: Boldery Park, 2.iii.1957, E. N. Marks, from *Alocasia macrorhiza* Schott, 2 ♂, 3 ♀, 4 pupal exuviae (USNM).

Unplaced *Forcipomyia (Phytohelea)* species

The following four species of *Phytohelea* cannot be placed in a species group because only the male is known.

*Forcipomyia (Phytohelea) fijiensis* (Macfie)

Figs. 42-44

*Apelma fijiensis* Macfie, 1945:1 (♂; Fiji; fig. genitalia).

Type.—Holotype ♂, Korobaba, Fiji, 21.vii.1943, R. A. Lever, "*Pandanus axil*" (on slide, in BMNH).

Discussion.—Through the courtesy of Richard Lane and the Trustees of the British Museum (Natural History), we were privileged to borrow the holotype male and to remount it for close examination of the genitalia. As noted by Macfie (1945), the male palpus (Fig. 44) is unusually short and stout, and the 3rd segment bears a deep sensory pit with a small opening. The empodium is present only as a slender, threadlike filament with a slight terminal swelling. The aedeagus (Fig. 42) is slightly broader proximally than figured by Macfie, while the apices of the distal processes appear truncate in ventral view. In ventral view the distal lobes of the parameres appear as broad, leaflike, obtusely pointed plates, each with a darkened ventral carina, and in lateral view this carina is seen to bend abruptly ventrad from the main body of the paramere.

*Forcipomyia (Phytohelea) hamaticauda* Tokunaga

*Forcipomyia (Trichohelea) hamaticauda* Tokunaga, in Tokunaga and Murachi, 1959:212 (♂; Caroline Islands; figs.).

Type.—Holotype ♂, Melekeiok, Babelthuap I., Palau Is., 22.v.1957, C. W. Sabrosky, light trap (Type no. 64597, USNM).

Specimens examined.—CAROLINE ISLANDS: Palau (holotype ♂). The holotype in the USNM was unfortunately mounted in Hoyers' medium and is now in very bad condition, unsuitable for examination.

*Forcipomyia (Phytohelea) keilini* (Saunders)

*Apelma keilini* Saunders, 1925:265 (larva, pupa, male; Brazil; figs.).

*Forcipomyia (Phytohelea) keilini* (Saunders); Wirth, 1974:9 (combination).

Types.—Syntypes, 3 larvae, 3 pupae, 1 ♂ (alcohol) from terrestrial bromeliads in woods behind Pernambuco (Dois Irmãos), Brazil, 10.ix.1923, L. G. Saunders (BMNH).

Specimens examined.—None available.

*Forcipomyia (Phytohelea) sabroskyi* Tokunaga

*Forcipomyia (Trichohelea) sabroskyi* Tokunaga, in Tokunaga and Murachi, 1959:211 (♂; Caroline Islands; figs.).

Types.—Holotype ♂, Ngaremlengui, Babelthup I., Palau Is., 1.vi.1957, C. W. Sabrosky, light trap (Type no. 64596, USNM).

Specimens examined.—CAROLINE ISLANDS: Palau (holotype ♂). As in *F. hamaticauda*, the type of *F. sabroskyi* was also mounted in Hoyers' medium. It has turned opaque and is unsuitable for examination.

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